Humean laws and pattern-subsuming explanations

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Abstract

A long-standing charge of circularity against regularity accounts of laws has recently seen a surge of renewed interest. The difficulty is that we appeal to laws to explain their worldly instances, but if these laws are descriptions of regularities in the instances then they are explained by those very instances. By the transitivity of explanation, we reach an absurd conclusion: instances of the laws explain themselves. While drawing a distinction between metaphysical and scientific explanations merely modifies the challenge rather than resolving it, I argue that it does point us towards an attractive solution. According to Humeanism, the most prominent form of the regularity view, laws capture information about important patterns in the phenomena. By invoking laws in scientific explanations, Humeans are showing how a given explanandum is subsumed into a more general pattern. Doing so both serves to increase our understanding and undermines a principle of transitivity that plays a crucial role in the circularity argument.

Keywords: Laws of nature · Grounding · Explanation · Humeanism · Lewis

1. Introduction

One of the most influential accounts of laws of nature is the regularity account, which takes the laws to be descriptions of regularities that occur in the world. This is most commonly associated with Humeanism, understood here as a rejection of irreducible necessity in nature. However, the Humean approach to laws has long been subject to the criticism that the laws it offers fail to back the sorts of explanation that we standardly take laws to be involved in.[1] This criticism has recently seen a resurgence of interest, and a corresponding flurry of papers have been published on the matter. The aim of this paper is to identify a crucial feature of Humean laws that underwrites their ability to support the explanations we find in both folk and scientific practice. Since the resulting explanations do not support a principle of transitivity crucial to the circularity objection, I claim that this feature is one which all successful Humean responses to the challenge ought to share in. By focusing on this commonality in Humean accounts rather than the specifics of one in particular, it is hoped that this defence will be compatible with a range of pre-existing commitments.[2]

The following section begins with a recap of the most well-known Humean account of laws, the Best System Account, and then turns to the motivation behind the accusations of circularity. Barry Loewer's distinction between metaphysical and scientific explanations has shaped much of the recent debate in this area and Sect. 3 offers an illustration of this important distinction. In response to Loewer, it has been argued that these forms of explanation are connected by a principle of transitivity. Since we can chain metaphysical and scientific explanations together

[1] A classic early statement of this is Armstrong (1983) p. 102.

[2] And so might be contrasted with more controversial solutions, like the 'contrarian' Humean in Miller (2015).

to form new scientific explanations, the Humean account is still subject to a revised circularity argument (Sect. 4). The paper then shifts to a diagnosis of the issue and argues that the sense of explanation at play is an inappropriately strong one (Sect. 5). As there is another sense of explanation available, one linked to our understanding of phenomena, Humeans are free to reject the one present in the circularity argument. In Sect. 6, I then offer a positive proposal for what feature Humean accounts of explanation should share: a commitment to scientific explanation involving subsumption of the explanandum into a more general pattern. This feature is both an independently motivated aspect of well-known accounts of explanation and one that undermines the motivation for accepting the troublesome transitivity principle.

2. Humeanism and the circularity argument

The Humean denial of necessary connections blocks off certain views about the nature of scientific laws. As metaphysically productive concepts like governance are not obviously available on this view, Humeanism is associated with regularity accounts of law.[3] The most popular way of then distinguishing between lawful and accidental regularities is the Best System Account.[4] According to this account, the various ways in which we can systematise truths about the world differ with respect to how informative and how simple they are. These two virtues trade off against each other, as including more facts about the world strengthens the system at the price of making it less simple. The system that achieves the best balance of

[3] See Beebee (2000). For an argument that it is still be possible to maintain that Humean laws govern in an interesting sense, see Roberts (2008).

[4] See Lewis (1983) pp. 365-68. While the Best System Account has been criticised and refined in various ways, the basic form is sufficient for the purposes of this paper.

theoretical virtues gives us the laws. More specifically, the laws are the universal generalisations included as axioms in the best systematisation of the world's facts. Let's call the collection of facts that determine the laws 'the mosaic'.[5]

One of the roles commonly ascribed to laws is that they must be able to explain their instances. But, goes the objection, this is something that the regularity view of laws cannot give us. The core worry is that the laws are what they are in virtue of the way the world is, and hence they cannot explain why the world is that way. Attempts to do so are guilty of circular reasoning. If the fundamental state of the world explains the fundamental laws, then we cannot immediately turn around and explain the world's state by appeal to these very laws. Otherwise we would be claiming that the fundamental state of the world explains itself, only with the additional use of laws as an intermediary.

This is an objection commonly voiced by anti-Humeans.[6] It has some intuitive force to it. Suppose it were a law that all ravens are black and, upon coming across a particular black raven, I were to ask why it was black. Our usual way of thinking about scientific laws suggests an immediate answer to the question: this raven is black because it is a law that all ravens are black. In other words, an instance of the law is explained by appeal to that law. However, anyone who provides an account of laws that takes them to be regularities faces a problem here. If the law that all ravens are black is a law because it is a regularity – perhaps one that possesses other features, such as being a part of the best systematisation of the world's facts – then the reason it holds at all is ultimately because of the fact that there are ravens and the fact that they

[5] The aim of this broad characterisation is to avoid the controversies about the precise nature of the facts within the mosaic. While the connection between the mosaic and the laws was not originally stated in terms of the grounding relation, it is not uncommon to see contemporary Humeans make this association.

[6] For example, Lange (2013) p. 256 and Maudlin (2007) p. 172.

are black. But if the reason that this raven is black is because of the law and the reason that there is such a law is because of the black ravens, then we have an explanatory circle going on. For one of the law's instances is a partial explanation of the law and so at least a partial explanation of itself. And self-explanation is a high cost for Humeanism to bear.

In order to assess the options open to Humeans, it will be useful to have a clear statement of exactly what this argument for explanatory circularity is. Hicks and van Elswyk provide a particularly clear formalisation of the objection:

(P1) The natural laws are generalisations.

(P2) The truth of generalisations is (partially) explained by their positive instances.

(P3) The natural laws explain their instances.

(P4) If *A* (partially) explains *B* and *B* (partially) explains *C*, then *A* (partially) explains *C*.

(C1) The natural laws are (partially) explained by their positive instances.

(C2) The instances of laws explain themselves.[7]

While it might be more accurate to say that the instances of laws (partially) explain themselves, the problem this argument raises for the Humean account is evident. Even partial self-explanation would be an undesirable consequence of a regularity theory of laws. Worse, the tension between the Humean grounding of laws in the mosaic and transitivity allows problem cases to multiply. If the reason why this raven is black is because it is a law that all ravens are black, and this is a law partially because of each instance of a black raven, then the fact that

[7] Hicks and van Elswyk (2015) p. 434.

ravens a century from now are black is part of the explanation why *this* raven is black.[8] This is a strong claim, and at the very least it would be better for Humeans to not be forced into accepting it.

3. Metaphysical and scientific explanations

According to one influential response to this argument, for Humeanism about laws to be guilty of an explanatory circle, the explanations appealed to must be of the same kind. If we use *A* to explain *B* and then use *B* to explain *A* in the same kind of way, then, intuitively, there is something wrong with the explanation being offered. But if *B* is used to explain *A* in a different kind of way from the first case, then intuition may not tell against this. To put it another way, we might be prepared to grant that the transitivity principle in (P4) of the formalised argument holds for one kind of explanation, but resist the claim that transitivity will hold across different kinds of explanation. That is exactly the approach that I will describe in this section.

For this to work when applied to laws, of course, we will need to see some details as to exactly what the different kinds of explanation appealed to are supposed to be. Loewer has suggested that there is such a distinction between metaphysical and scientific explanations.[9] Metaphysical explanations are concerned with constitution in some way. To say that *A* metaphysically explains *B* is to say that *B* is grounded in *A*, or that *B* holds in virtue of *A* or that *B* is constituted

[8] This is suggested by Miller (2015) pp. 1324-25 and echoed by both Marshall (2015) p. 3152 and Lange (2018).

[9] Loewer (2012) p. 131. See also his (2007).

by *A*.[10] An explanation of this sort does not need to cite laws. If explanans and explanandum are both temporal entities, then they must be co-temporal. This latter point captures the following idea: if we want to say that *A* is the underlying stuff out of which we get *B* then they clearly must both exist at the same time. It would make little sense to claim that *B* is constituted by something no longer around.

Scientific explanations do not need to mention grounds in that way. Rather, Loewer suggests that the core of scientific explanation of some event is showing why that event occurred through appeal to other events and certain laws. If *B* scientifically explains *A*, then events mentioned in *B* will typically be temporally prior to events in *A*. That said, this is not a strict requirement since there is no requirement that the explanans or the explanandum be temporally located entities. Another difference between the two kinds of explanation is that scientific explanations may be probabilistic while metaphysical ones cannot. The thermodynamic explanation of the melting of an ice cube in warm water proceeds by way of showing that this melting is highly probable, yet there does not seem to be an equivalent for constitutive explanations: if we claim that the water in that ice cube consists of H_2O molecules, notions like chance or probability do not appear to have any role to play.

This is far from a full account of scientific explanation. That said, it is not intended to be one. Loewer is simply trying to give some characterisation of what the kind of scientific explanation he has in mind is. To see how it is distinct from metaphysical explanation, let's consider the example of Arbuthnot's regularity.[11] The regularity which forms our explanandum is simple:

[10] More details about the contemporary notion of grounding can be found in Fine (2012) and Rosen (2010). The link between grounding and explanation specifically is considered in Jansson (2016).

[11] A discussion of Arbuthnot's regularity and explanation can be found in Kitcher (2001) p. 71. See Frisch (2011) for further discussion. The relevance of this example to Loewer's distinction was first brought to my attention in a talk by John Roberts.

over an 82 year span from 1623 onwards, more boys than girls were born in London. Calling this mere coincidence is hardly credible given how unlikely this is to have come about by chance. But there are two kinds of explanation on offer for this regularity. Take the metaphysical explanation first. We may not have such an explanation presently available, but we can sketch out the form it might take. Take the fundamental laws of physics and assume that they are deterministic. Now take the exact state of all of the fundamental physical particles at some point prior to 1623.[12] As the laws are deterministic, we can now in principle derive the positions of the particles for any later time, and for the relevant 82 year period in particular. Associate some distributions of particles with the birth of a boy and some other distributions with the birth of a girl. Count the number of boy-birth distributions and compare it to the number of girl-birth distributions for each of the 82 years. We can clearly see that more boys than girls were born in London each year!

There is a sense in which this constitutes an explanation of the Arbuthnot regularity. We have given the details (or, at least, the form such details take) of what the regularity might fundamentally consist in. The regularity obtains in virtue of such-and-such fundamental physical facts. But it is also easy to see what this explanation misses. Most obviously, it is an 'in principle' explanation: we do not have epistemic access to the world's fundamental state prior to 1623, we do not believe we have discovered what the fundamental laws actually are and we cannot even decide whether such laws will turn out to be deterministic. However, even if we had all of this information available to us, the explanation would still be missing out on something. The offered explanation does nothing to help us understand why the regularity is not some big coincidence: why this particular fundamental distribution that generates the

[12] If the relevant laws are invariant across time-reversals, then we can take any point in time that we please.

Arbuthnot regularity when so many others are possible? Furthermore, the explanation explains too much. For this explanation not only explains the Arbuthnot regularity but also every other event and regularity that occurs after the time associated with the given state of the particles. So the very same explanans will explain my habit of drinking tea, the first moon landing, and the rise and fall of alien empires in other galaxies. The sense in which this is an explanation of the *Arbuthnot regularity* is perhaps a rather slim one.

So, there is plenty of room for an alternative to the metaphysical explanation just given. Contrast this with Fisher's neo-Darwinian explanation of the regularity. In any population which differs from a 1:1 ratio at sexual maturity, there is a selection pressure in favour of producing more offspring of the sex that is not as well represented. If one sex in a population is more vulnerable than the other, and so less likely to reach sexual maturity, natural selection will favour a birth ratio skewed towards the more vulnerable sex. In humans, males are more vulnerable than females: boys are more likely to die before puberty than girls. Any large human population which fails to birth more boys will experience a selection pressure towards having more boys. This is why Arbuthnot observed this regularity; because of natural selection, every year is likely to be a year in which more boys are born than girls.

This scientific explanation does not generate the same sense of mystery as the metaphysical one given previously. The regularity in the London births no longer appears to be a coincidence, but rather something we should expect to hold. This is a virtue of the second explanation in that it grants a greater understanding of the explanandum than the first does. We might also note that this explanation is more specific than the first. It does explain more than just a regularity in seventeenth-century London – it explains similar birth trends across different places and times – but it explains far less than the first does. By appealing to the entire

fundamental state, the metaphysical explanation explains every regularity that holds. So the explanations differ in the variety of explananda that they cover.

4. The revised circularity argument

A challenging line of response is given by Lange.[13] Grant that there is a distinction between scientific and metaphysical explanations. Grant also that the holding of some explanatory relation between *A* and *B*, and another explanatory relation between *B* and *A* does not automatically entail that either explanation is viciously circular. Even so, Loewer's distinction will not save the Humean account. The problem is that these two kinds of explanation are connected to one another by a transitivity principle. Here is the original statement of it:

> If E scientifically explains [or helps to scientifically explain] F and D grounds [or helps to ground] E, then D scientifically explains [or helps to scientifically explain] F.[14]

The motivation for this update to our first transitivity principle is straightforward. If *D* is the ground of *E*, then *E* obtains because of *D*. If metaphysical explanation is concerned with constitution, then we can say that *E* is constituted by *D*. Any role that *E* plays, it plays because of the way it is and *D* is what makes *E* the way it is. So if *E* is involved in the scientific explanation of some other fact then *D* must also scientifically explain that other fact.

This allows us the run the argument against Humeanism again. The laws scientifically explain the mosaic, while the mosaic metaphysically explains the laws. By the transitivity principle,

[13] Lange (2013) and (2018).

[14] Lange (2013) p. 256.

the mosaic must scientifically explain whatever the laws scientifically explain as it is only in virtue of the mosaic being a certain way that we have these laws to explain with. Hence the mosaic scientifically explains itself.

Bhogal makes the case that even if the Humean finds examples where this sort of explanatory transitivity fails, we still need an account of why this is sometimes taken to be possible:

> For example, we can chain together (i) a scientific explanation of the facts about the energy of the particles in this room from facts about those particles ten minutes ago, with (ii) a metaphysical explanation of the fact about the current temperature of the room in terms of facts about the energy of the particles in the room, to form (iii) a larger scientific explanation of the fact about the temperature in this room from the facts about the particles ten minutes ago.[15]

Clearly this sort of chaining together of explanations to form a scientific explanation from the grounds of some other explanatory fact is sometimes done. This is *prima facie* motivation to think that Lange's transitivity principle – or something very much like it – does hold. But the importance of this example is not merely to motivate that principle. Rather, they give us a better understanding of the challenge that the Humean faces: the project is not only to show that the transitivity principle does not hold generally, but to do so in a way that does not condemn all instances of such explanation transitivity. It must remain possible, after the Humean has offered a defence of the distinction between different types of explanations, for this chaining together to sometimes be a legitimate move. Taking a straightforward example, this rules out claiming that each explanandum has a unique scientific explanans. An argument for this would rule out the transitivity principle, since *E* and the grounds of *E* would not be able to both scientifically

[15] Bhogal (2017) p. 3. I take the challenge raised by these chained explanations to be the same as that raised by the combined explanations of Roski (2018).

explain some *F*, but would leave it completely mysterious as to why we think explanations like the one in Bhogal's example are legitimate.

With this discussion in mind, we can now consider the explanatory circle argument that Humeans adopting Loewer's distinction must face:

(P1') The natural laws are generalisations.

(P2') The truth of generalisations is (partially) metaphysically explained by their positive instances.

(P3') The natural laws scientifically explain their instances.

(P4') If *A* (partially) metaphysically explains *B* and *B* (partially) scientifically explains *C*, then *A* (partially) scientifically explains *C*.

(C1') The natural laws are (partially) metaphysically explained by their positive instances.

(C2') The instances of laws (partially) scientifically explain themselves.

Let us take this to be the objection that Humeans are challenged to overcome. The question now is how best to do that. The next section considers what I take to be the most promising line of response.

5. The aim of scientific explanations

Attempts have been made to question the direction of the grounding relations in play here or to reconsider the motivation for accepting the transitivity principle.[16] However, I shall suggest that the problem lies in the notion of explanation being appealed to. The sense of explanation at play is a strong one and it is possible for Humeans to reject it as inappropriate given their wider commitments. Doing so opens up two possible routes of response to the circularity argument: (i) claim that laws are not able to explain their instances, or (ii) develop an alternative view of explanation that allows for laws to explain their instances without thereby supporting a principle of transitivity. In what follows, I will set out both responses but focus more closely on the latter, as this is not in tension with scientific practice.

Much of the literature responding to the explanatory circle argument has avoided giving a full account of what scientific explanation involves. There are good pragmatic reasons to do so: tying one's response to a particular account of explanation creates problems if that account brings with it unanswered objections, and, further, Humeans themselves adopt a range of different accounts. It is undesirable to only respond to the circularity worry on behalf of those who are committed to the same particular details about explanation as oneself. However, despite the advantages of neutrality here, there is something substantial that we can say about the strength of the explanation involved: it is stronger than Humeans should be comfortable with. This can be most clearly seen in a representative quotation from Lange:

[16] Miller (2015) and Hicks and van Elswyk (2015).

> In short, if the Humean mosaic is *responsible* for making certain facts qualify as laws, then the facts about what the laws are cannot be *responsible* for features of the mosaic.[17]

The first sort of responsibility is the sort of responsibility that accompanies the grounding relation. Even if one is suspicious about grounding and distinctively metaphysical explanations, there is a clear sense in which Humeans take laws to be (partially) constituted by events in the mosaic. However, the second mention of responsibility is rather odd. On the Humean view, laws are mere descriptions. They do not govern or constrain or make anything happen. Of course they are not responsible for the mosaic; Humean laws are not responsible for anything! Ultimately, nothing is responsible for the mosaic being a certain way. It is a brute fact that the world is one with *this* patterns of events, as opposed to any other. This is captured by the famous Humean denial of necessary connections, the ban on which prevents anything from taking responsibility for the mosaic turning out one way rather than another.

The second part of Lange's quote is picking out a core commitment of the Humean view, yet Lange himself takes it to express an objection: that the laws are not responsible for the mosaic is supposed to be a problem. Perhaps the lack of responsibility that laws show is an unattractive feature of the account for its detractors. But that in itself is not a strong objection, especially when Humeans find the notion of responsible laws mysterious. A telling objection is one that its target will recognise as a challenge, but if the mosaic ultimately admits of no deeper explanation then the account's lack of one does not look like a deficiency.

A belligerent Humean might wish to push this point. The problem with the explanatory circle argument is that it assumes that laws can scientifically explain their instances in the sense of

[17] Lange (2013) p. 256, italics added for emphasis. While I single out Lange in this section, see Bird (2007) pp. 86-90 and Maudlin (2007) p. 172 for similar claims.

being responsible for them. Since explanation here is being meant in a strong sense, such a Humean does not take laws to be capable of doing that. In effect, this is a rejection of the argument's third premise. The explanatory circle is broken as one of the directions of explanation does not obtain. On this view there is no need to engage with the transitivity principle: while events in the mosaic metaphysically explain the laws, those laws do not scientifically explain the events and so there is no risk of the events scientifically explaining themselves.

Denying the third premise both blocks the circularity argument and fits in nicely with the Humean conception of laws as playing a descriptive role. But it comes at a great price, for this denial of their role in scientific explanations stands in conflict with both a commonsense belief about laws and how scientists are wont to use them. Perhaps the conflict with the folk usage can be explained away. After all, governance is commonly associated with laws but Humeans are committed to denying that they play that role. A degree of revisionism might be justified on the grounds that it comes with a more attractive metaphysics. But the ascription of error to working scientists is not so easily dealt with. One of the main motivations for adopting a Humean view is a respect for science and a suspicion of claims that science cannot grasp the nature of the world without some form of metaphysically weighty supplementation.[18] To claim that scientists are misusing laws and should revise this usage on metaphysical grounds is, at the very least, in tension with this motivation.

When confronted with the bullet that needs to be bitten on the route just described, many Humeans will wish instead for a more moderate line of response. Such a response will have to concede that laws can indeed help to explain their instances. It can, however, ask what reason there is to think that the kind of explanation appealed to in the argument is the kind of

[18] This is particularly clear in Lewis (1994) p. 474.

explanation that Humean laws can provide. In other words, if anti-Humeans like Lange are appealing to a strong or 'thick' form of explanation in their objection, then it is open to Humeans to rescue the explanatory role of laws by appealing to a 'thinner' form of explanation. The question that then remains is what kind of explanation is involved in this thin form.

Let us begin to answer this by noting that there are often several distinct explanations that can be given in response to a why-question. Consider two simple questions:

(Q1) Why is this rock heavy and hard?

(Q2) Why is my window broken?

One way to respond is to tell you what the phenomenon consists in. This rock is both heavy and hard because it is made of granite. Your window is shattered because the components of the window are disconnected from one another. These explanations are constitutive, and are most naturally seen as instances of the metaphysical explanation Loewer appeals to. I might instead offer some kind of causal story to inform you how the phenomenon was brought about. The rock has these properties because it was formed through the crystallisation of magma several thousand years ago. Your window is in its current state because Suzy threw said rock through it. Alternatively, I might fit this phenomenon into a more general pattern. It is no surprise that this granite rock is hard and heavy since all granite rocks have such properties. Your window is broken because every house on your street had a window broken last night. These two are clearly not constitutive explanations, and they make no explicit appeal to causal mechanisms. One might worry that they nevertheless contain disguised appeals to such causal mechanisms, but let us set this interpretation aside for now as it will be dealt with in the following section. These ways in which explanations can differ is intended to be illustrative rather than exhaustive as there are other kinds of explanation too. For example, the breaking of

your window might be explained by referring to intentions or mental states: Suzy bears you a grudge.

Which kind of explanation is the 'right' response to the question being asked is context-sensitive.[19] Upon discovering that your window is broken it is unlikely that you will respond by querying what it is for a window to be in a broken state. You already understand that, so my offering such an explanation would miss the point of the question. Perhaps what you are hoping for is the causal story. But some questions are more ambiguous. If you ask why the rock has the density that it has, it might not be immediately clear whether you are inquiring into its constitution or its causal history. But just because one kind of explanation is a more relevant answer to a specific question, it does not follow that the others fail to be explanatory. The rightness of which explanation to offer in response to a question is a question of fitting conversational norms, not the result of a winner-takes-all competition that eliminates the other competitors.

At this juncture, one might be inclined to wonder what makes all of these count as explanations. If they have different features and, as will be claimed later, can hold between two relata so as to form a circle without falling into viciousness, what justifies uniting them under 'explanation'? One way to answer this is to consider the aim of explanations.[20] Explanations seek to increase our explanatory understanding of the world through enabling us to answer *what-if* questions. The more such questions that one can correctly answer, the greater one's explanatory understanding. The explanations of the rock and the window mentioned above all

[19] A point famously emphasised by van Fraassen (1980).

[20] The account described below draws from Ylikoski and Kuorikoski (2010). An alternative pluralistic approach to explanations and understanding is offered by Salmon (1989) pp. 134-35.

identify features of the world that back answers to various *what-if* questions. Picking out these features furnishes an agent with the ability to respond correctly to more such questions than would otherwise be possible and so increases the agent's explanatory understanding of the world. It is in virtue of supporting such increases in understanding that the mentioned responses deserve to be called explanations.

A useful advantage of adopting this account of the aim of explanation is that it captures the sense in which the various responses are all offering explanatory information. There is a pragmatic element to increasing explanatory understanding, as this is linked to how easily creatures like us can answer questions. This is why adding further accurate information about events will not always improve an explanation: the explanation of your broken window that mentions Suzy's throwing of the rock and recent goings on in Alpha Centauri is no better than the explanation that mentions Suzy's actions alone. Arguably it is worse, as the presence of irrelevant information serves only to distract from the relevant information and so interferes with the ability to respond to *what-if* questions. By focusing on different aspects of the world's events, the various explanations provide information that supports the answering of different *what-if* questions.

Much of the literature on the alleged circularity of Humean explanations is carried out under the assumption that explanations are 'factive' in that they pick out mind-independent relations in the world. One might worry then that the pragmatic elements of this connection between explanation and understanding undermines the ontic interpretation of explanation and so is of little use in responding to the anti-Humean camp. The problem is not merely that, as just noted, successful explanations omit information, but that through approximations and idealisations scientific theories make explanatory use of information that is not true. If successful scientific

explanations can make use of false information, then we appear to lose our grip on explanations marking out connections between *facts*.

One option at this point is to embrace the non-factive aspects of explanations and give up on the ontic interpretation.[21] As this stands in tension with both the focus of the current debate on Humean explanation and with a broader commitment to scientific realism, I will not pursue this strategy further here. Instead I will adopt a view suggested by Ylikoksi and Kuorikoski, and pursued by Saatsi.[22] The sense of explanatory understanding being appealed to is not a psychological one. That is, it is not understanding in the Archimedean "Eureka!" sense, but rather an agent's ability to correctly answer *what-if* questions. The ability to answer more questions accurately is dependent upon the agent's ability to grasp relevant connections that obtain. An entirely false explanation that does not capture any of these connections fails to aid agents in this task as it will not underwrite any further correct answers. Explanations that incorporate a more moderate degree of falsehoods (such as those offered by our current scientific theories) are justified in doing so on account of helping agents to grasp mind-independent relations that are relevant to the explanandum to a greater extent than alternative explanations that do not involve these falsehoods.

The approach just described is a realist stance towards scientific theories supported by a commitment to the connection between scientific explanations and features of the world. These explanations come in various forms, influenced by non-factive considerations related to the ability of agents to reason counterfactually. They are nevertheless united as explanations due to their supporting increased understanding. The next section takes this stance towards the aims

[21] As does de Regt (2017).

[22] Ylikoski and Kuorikoski (2010) and Saatsi (forthcoming).

of explanation and applies it to the Humean view of scientific explanation. I then argue that the resulting explanations do not run afoul of the explanatory circle argument.

6. Explanations as pattern subsumption

Recall that Humean laws are nothing more than particularly efficient ways of marking out important patterns in the world's events. Consequently, by Humean lights all scientific explanations that involve appeal to laws must thereby involve appeal to generalisations. To appeal to generalisations in this way is to draw the current explanandum into a wider network of events, treating it as another instance of a general pattern. In other words, scientific explanations that involve laws should be treated as cases of subsumption under a pattern.

Such acts of explanation are not unusual. If we relax our focus from explanations offered by working scientists, we can see that they are, in fact, commonplace. This raven is black because all ravens are black. I sit at the back of the lecture theatre because all of the cool kids sit at the back of the class. The All Blacks performed a haka before their last match because they always perform a haka before matches.

Two comments are relevant here. First, I have been careful to specify that we are only treating scientific explanations in this manner if they appeal to laws. One might then wonder whether there are any scientific explanations that do not involve laws and, if so, what a Humean might have to say about those. Such explanations might be found in special sciences like ecology, where the complexity of and variation within the studied domain is often taken to suggest that there are no exceptionless principles available to play the role of laws. Yet modelling

techniques are still used in pursuit of explanatory and predictive aims.[23] On an orthodox Lewisian view of laws in the best system, non-fundamental regularities will only get counted as laws if they are deducible from the fundamental regularities that are counted as laws.[24] However, it is not clear that this will always be possible and, given the lack of any serious attempts to provide such a deduction, we have little reason to believe that any given special science regularity will get counted as a law by this account. Alternatively one might take this view from less metaphysical considerations, as Beatty does when dealing with biological laws. Beatty's concern is that biological 'laws' are either (a) just laws of more fundamental sciences or their deductive consequences, or (b) merely contingent accidents.[25] In the former case, we lack any new distinctively biological law. In the latter case, there is nothing to distinguish between these regularities and the other accidental ones, suggesting that they are not laws at all.

Regardless of how one motivates this worry, there is nothing in the present account that is threatened by it. Perhaps there are scientific explanations that make no mention of laws. If so, special sciences like biology are a natural place to look for them. But the circularity worry was not motivated by how Humeans treat scientific explanations in general, but by how they treat the laws that, at least some of the time, are involved in those explanations. In short, a scientific

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[23] Elith and Leathwick (2009) provide an overview of how this is achieved in the case of species distribution models.

[24] Lewis (1983) p. 368. In principle they might also be counted as laws if they are included as axioms in the best system, but this is highly unlikely to occur given the restriction to perfectly natural properties that the balancing competition considers.

[25] Beatty (1995) pp. 46-7. The reason for thinking them to be contingent is that they lack the stability we associate with fundamental laws; the evolutionary process could have easily resulted in different biological rules holding.

explanation that makes no mention of laws will not be viciously circular since it lacks the allegedly circular feature. The question of how to treat such explanations remains, of course, but the answer is dependent upon one's views on scientific explanation more generally. The purpose of this paper is to argue that Humean theories of explanation should have a feature in common with each other, one that prevents them from being circular in the way anti-Humeans suggest. This is compatible with there being more than one theory of explanation available: individual Humeans should look to their favoured one to determine how they should treat these lawless cases.

The second comment is more substantial. In the previous section, I briefly noted the worry that some of the indicated kinds of explanation are nothing more than disguised appeals to other kinds of explanation. That is, the variety of explanations on offer is smaller than I have taken it to be and explanations involving pattern subsumption in particular are explanatory only insofar as they point us towards underlying explanations that are doing all of the genuine explaining. Lange quotes with approval an example from Carroll where the students in a classroom explain their presence by pointing out that they are always present at that time.[26] For both Carroll and Lange, this is not a case of a regularity or pattern explaining its instances. On their view, that there is such a pattern indicates that there are other reasons for the students' presence (such as their intentions). And it is these other reasons that are genuinely explaining why the students are in the classroom. The initial explanation mentions the pattern of attendance not because that pattern explains their presence but because it points to other reasons that do the explanatory work. It just happens that the explanation offered does not cite those other reasons directly.

[26] Lange (2018). The example is drawn from Carroll (1999) p. 79.

There is undoubtedly something to be said for this response. There does seem to be a difference between fitting some phenomenon into a more general pattern and providing the mechanisms by which it was brought about. But that alone does not indicate that the pattern-based explanation fails to be explanatory. We have already seen that one can gain understanding in different ways. Much of the intuitive force behind the claims made by Carroll and Lange could well be because we are aware that alternative kinds of explanation are available. Perhaps we often find that causal explanations offer a greater understanding of an event than pattern recognition does, in the sense of better preparing us to answer *what-if* questions. But the existence of a 'stronger' or 'thicker' form of explanation does not mean that thinner kinds of explanation are either not explanatory or only derive their explanatoriness from the thicker kinds. Going further, there are cases where the recognition of a pattern provides a different kind of understanding to one, say, based on causal mechanisms. The smashing of your window is one such example. By drawing your smashed window into the wider case of your street's smashed windows, I can provide you with a different understanding of the event than if I had told you about Suzy throwing a rock through it. This different understanding will support the answering of *what-if* questions in different contexts. For example, the question of what would have happened to your window if you had been living on a different street will likely receive different responses depending on the explanation of the explanandum that one has received.

While the example that Lange and Carroll use might seem initially appealing, we should note that this appeal fades when we consider other cases where similar explanations are offered. As an example, suppose that I were to ask why that bird outside my window is black. You might well point out that the bird outside the window is a raven and all ravens are black. This is, of course, an instance of a more general explanation pattern: that entity is *G* because it is *F* and all *F*s are *G*. Your answer's appeal to a regularity would not normally be considered as preventing it from being an appropriate explanation to offer. This is so even though there are

alternative explanations that could have been given, ones that Lange might expect to be doing the genuine explaining. That bird looks black because the molecular structure of its feathers absorbs certain wavelengths of light, preventing them from being reflected into our eyes. This response picks out the underlying feature that black ravens have in common, and is also an appropriate explanation. It does not, however, undermine the first explanation as each supports the answering of different *what-if* questions: consider the answers that each explanation supports to the question of 'what if a different raven had been outside the window?'.

Returning to the Humean account of laws, this provides a way to avoid being committed to laws being responsible for events without ascribing widespread error to scientists. The explanation Humeans can provide of the laws is a constitutive one: the laws are grounded in the patterns that occur in the mosaic. The explanation of the mosaic via the laws cannot be one in which the laws are taken to have any responsibility of the goings-on in the world. Rather, the explanations that invoke the laws are explanations in the form of pattern recognition. If I say that my pen falls because of gravity, I am pointing out that massive objects show a general pattern: they move towards one another. As my pen has mass, it is just another instance of this pattern. I have not attempted to identify something that acts on my pen to ensure that it moves downwards. Nor have I tried to find why this is a world with a gravity-pattern in it (that would presumably be an attempt to find a deeper reason that Lange takes appeals to regularities to be pointing towards). In fact, I had better not try to do this if I am a Humean! Ultimately, there is no deep reason why the world is one with this pattern of events as opposed to another one. For Humeans, there simply is no explanation of that kind of the mosaic to be had.

The importance of this line of reply is not merely that it utilises a different sense of explanation to that employed by anti-Humeans in the debate. That alone would be insufficient because the circularity argument could simply be reformed with reference to this thinner sense. Notions

like responsibility are useful in describing the challenge, but are not directly appealed to in the argument itself. Rather, the important point is that it undermines support for the argument's fourth premise: the transitivity principle. This principle has some plausibility when we think of explanations as offering something like causal information. If *E* brings about *F*, and *E* is really just made up from *D*, then it is not unreasonable to think that *D* brings about *F*. That kind of neat story is not available when it is patterns that we are interested in. Suppose that *E* explains *F* by treating it as part of some wider pattern and that *E* is grounded in *D*. There is nothing to guarantee that *D* will be able to explain *F* in the same way that *E* does as patterns evident amongst the *E*-facts might not be apparent amongst the *D*-facts. This is particularly true if we think of the world as having levels of increasing fundamentality, for the lower-level facts might be so different in kind to the higher-level facts involved in the pattern that they will fail to subsume *F* within them.[27]

As this is clearer with an example, recall the contrasting explanations offered of Arbuthnot's birth-rate regularity. Here we have the lower-level explanation in terms of facts about the configuration of fundamental particles and the higher-level explanation in terms of a neo-Darwinian appeal to facts about vulnerability within a population and natural selection pressures. While both identify facts about the state of the world, we have already seen reason to prefer the latter one: the entire point of turning to an explanation like Fischer's is that the particle-based explanation does not properly capture what we're looking to get out of an explanation. The fact that the regularity still appears to be coincidental in an important sense in the latter explanation is evidence that the relevant pattern is not apparent when looking only at the lower-level facts.

[27] Envisioning the world as having levels of facts is a useful way to make the point clear. Nothing hinges on a commitment to such a hierarchy, however.

Of course, one might point out that this tells us more about our epistemic limitations than it does about the explanations involved. A Laplacian demon might have no issue recognising the relevant pattern, regardless of what kind of facts we state the explanation in terms of. But to make this response is to forget that the sense of explanation that I am suggesting Humeans appeal to is closely connected to our abilities and limitations. If an act of explanation cannot increase our understanding of the explanandum, then it fails to qualify as explanatory. The particle-based explanation does refer to the fundamental facts that serve as grounds for the regularity, but in failing to satisfy the non-factive considerations we take to be relevant to explanations it fails to show that the Arbuthnot regularity is part of a wider pattern. It consequently does not increase our understanding of the regularity, in that it does not increase our ability to correctly answer relevant *what-if* questions.

This move to seeing scientific explanations as forms of pattern subsumption is not without precedent in the explanation literature. The case is, in fact, quite the opposite: it has a long history. I mention here two prominent examples of accounts that Humeans might draw from in setting out their own stances on explanation. The point of this is not to argue for one over the other, or to claim that these two examples are the only options on offer. Rather, the point of focusing on the pattern subsumption aspect is to pick out the important feature that a Humean-friendly account of scientific explanation will include. This is compatible with there being multiple accounts that treat that feature as important to explanation. Ultimately, the point I am arguing for is that this feature does not support a principle of transitivity and so any account built around it has the resources to respond to the circularity argument.

The first example is that of the deductive-nomological account. Consider how Hempel talks about explanation:

> We noted that scientific explanation is not aimed at creating a sense of familiarity with the explanandum; "reduction to the familiar" is at best an incidental aspect of it. The understanding it conveys lies rather in the insight that the explanandum fits into, or can be subsumed under, a system of uniformities represented by empirical laws or theoretical principles…The central theme of this essay has been, briefly, that all scientific explanation involves, explicitly or by implication, a subsumption of its subject matter under general regularities; that it seeks to provide a systematic understanding of empirical phenomena by showing that they fit into a nomic nexus.[28]

We see here two important connections with the themes of this essay. The first is that there is a sense of understanding that comes from explanations: this sense is distinct from the "Aha!" one and is instead tied to recognising patterns in the world. This is related to the type of understanding that I earlier tied to our ability to correctly reason counterfactually, in that the occurrence of actual patterns underpins both of these. The second is the claim that scientific explanation involves subsumption under regularities. As has been discussed, this is a claim that Humeans should find themselves sympathetic to, given the Humean view of laws as particularly important regularities.

Alternatively, consider how Woodward discusses the connection between Humean laws and a unificationist account of explanation:

> It is natural to connect this conception of laws with unificationist approaches to explanation: if laws are generalizations that play a central role in the achievement of simple (and presumably unified) deductive systemizations, then by appealing to laws

[28] Hempel (1965) p. 488.

> in explanation, we achieve explanatory unification – this makes it intelligible why it is desirable that explanations invoke laws.[29]

Moving away from the precise details of any one unificationist account, the guiding idea behind these views is that explanation is based on reducing the number of facts that we have to treat as basic.[30] The fewer such basic facts we need, and the greater the range of phenomena that they tell us about, the better we are doing with regards to our explanatory goals. As Woodward notes, this fits nicely alongside a view that has laws occur in these explanations, and further claims that the laws are the result of a competition to find the best way to balance simplicity against comprehensiveness. If, for this reason, scientific explanation aims to unify by showing how a given explanandum is an instance of a law (and so demonstrates that the explanandum does not need to be accepted as basic), then it aims to draw that explanandum into a wider regularity. In doing so, the unificationist-Humean is committed to basing scientific explanation around pattern subsumption.

Again, the point of giving this two approaches to explanation is not to claim that Humeans must be committed to one specific account of explanation in particular. That would be unwise, given the heterogeneity of commitments that individual Humeans possess and the various objections that have been raised against both the D-N and unificationist accounts.[31] Rather, these serve to remind us that there are different stances compatible with the commitment to

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[29] Woodward (2017).

[30] For examples of such accounts, see Friedman (1974) and Kitcher (1981). Armstrong (1983) takes unification to be a mark of explanation when criticising the regularity account, although he does not acknowledge there the possibility of Humeans appealing to unificationism.

[31] Problem cases for the D-N model can be found in Salmon (1989) pp. 46-50. For issues with unificationism, see Woodward (2003) pp. 360-73.

scientific explanation as pattern subsumption. Further, they show that this commitment is not merely an *ad hoc* one, adopted to avoid the circularity argument: viewing explanation in this way predates Lewis' efforts to bring a neo-Humean view into prominence.

7. Conclusion

While the threat of circularity has long dogged the Humean account of laws, this paper has argued that the objection is based on a view of explanation that Humeans are free to reject. Even stronger than that, Humeans have good reason to reject it as there is an alternative account that fits more closely with the commitment to laws as regularities. If the laws are descriptions of patterns, then scientific explanations invoking laws explain by way of showing that the explanandum in question is an element of some pattern. Explanations based on pattern subsumption do not support the circularity argument as they defy the transitivity principle: that our understanding of the explanandum is increased by seeing how it fits into a pattern amongst certain facts does not mean that there will be a similar increase in understanding from a description of the phenomenon in terms of other facts.

In the third section, we saw that part of the challenge of accounting for how Humean laws explain was that we sometimes reason as if transitivity does hold. This was Bhogal's problem of chaining: if the transitivity principle does not hold generally, why is it that some metaphysical and scientific explanations can be chained together to form a legitimate scientific explanation? Specifically, why is it that we can chain together scientific facts about energy over time with metaphysical facts about the connection between energy and temperature to form a scientific explanation of a room's temperature over time?

Having seen why the transitivity principle fails, we are now in a position to comment on this challenge. Whether it is possible to chain these explanations depends on whether the

explanandum gets subsumed at the lower level into a pattern descried by a law. Unfortunately, this varies on a case-by-case basis: there is no way to provide a systematic way of telling if this will be possible from the comfort of the armchair. Rather, the discovery of when we can do so is a hard-won victory that is ultimately based on empirical investigation. That chaining is possible in Bhogal's example is due to the celebrated connection between thermodynamics and statistical mechanics, a connection that the practice of science – not metaphysics – demonstrated.

The Humean view is often associated with a suspicion of 'heavy-duty' metaphysics, the kind that introduces irreducible necessity into the world. The cost of avoiding such commitments is a thinness to the resulting explanations. To some, this cost will render the position unattractive: recall Lange's point about the laws not being responsible for features of the mosaic. The aim of this paper has not been to sway the anti-Humean camp on this. More modestly, it has been to show that if one is willing to accept Humean presuppositions about the world and the metaphysical resources we have available, then it is still possible to provide a sense in which laws can explain that does not require attributing widespread error to the scientific community. A consequence of the Humean account is that thicker explanations of the world's events are not available: it is ultimately a brute fact that we have this mosaic rather than any other. As such, the restriction to thinner explanations is no substantial cost to the Humean position.

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